AST 9508, Estrellas Variables

2017-2

Profesor: Márcio Catelan

Tarea 1

29/08/2017

Fecha de entrega: 13/09/2017[1]

Problem 1. The *General Catalog of Variable Stars* (*GCVS*) and *International Variable Star Index* (*VSX*) are compilations of variability data that have appeared in the literature. They can be accessed from the following URLs, respectively: http://www.sai.msu.su/gcvs/, https://www.aavso.org/vsx/.

a. Select at least one subclass of variable star among each of the eclipsing, pulsating, rotating, eruptive and cataclysmic subclasses, and provide an ***updated*** estimate of the corresponding number of variables in these subclasses that are contained in each of these catalogs, indicating the date/version of the database that you used in your work.

b. What is the constellation with currently the largest number of variable stars in the GCVS? What is the constellation with the smallest number of variable stars in the same catalog?

c. For the constellations cited in the previous item, how do the stars distribute into the various variability classes? Please comment.

Problem 2. PHOEBE is a computer program that is highly popular in the eclipsing binary community. Please download and install the program on your computer. The sources (and Windows installation package) are available on the course's web page, but if you wish, you can try to install the latest version from the program's web page as well (no GUI available yet though). Check out the tutorial at the /doc directory, and carry out a fit for the UV Leo system described therein. Provide a very brief (say, about one page) description of your results, with plots showing that you were able to obtain a good fit. (The purpose of this exercise is for you to gain some general familiarity with the code, so don't worry if you do not understand every parameter of the fit at this stage.)

[1] This assignment should be turned in electronically, in the form of a single pdf file. To gain familiarity with paper-writing, it is strongly recommended (but *not* mandatory) that you use LaTeX, along with the style files corresponding to a journal of your choice – you may want to check, for instance, AASTeX, EmulateApJ (my personal favorite), MNRAS, A&A, etc.

In the next two problems, you will be asked to compute periods of variability on the basis of empirically derived data. Some useful tools that you can use to compute these periods include PDM on IRAF, Period04, Peranso, etc.; see Sect. 2.3 in the book for extensive references, and Templeton (2004) for a useful review. (N.B.: Peranso is not free, but you will probably be able to use a trial version free of charge; I recommend that you explore the different features of this nice little program, which however is only available for Windows machines.)

Problem 3. In the course's web page you will find two files with *V*-band, ground-based photometry for two field variable stars. In these files, the first column gives the Julian Date (minus 2,440,000, in the case of star 1), while the second column shows the apparent magnitude in *V*.

a. Make a plot of magnitude vs. time for both stars.

b. Compute the variability period for each star, and plot the corresponding phased light curves, in the range of phases between 0 and 2. Pay attention to the number of significant digits used!

c. Estimate the corresponding precision in the derived periods. One simple (not very formal, but still acceptable) way to do this is to change your derived period by **very tiny** amounts, until you notice that a nicely folded light curve starts to become dubious. (More sophisticated methods are implemented in Period04 and Peranso, but this approach is sufficient for our purposes, and more intuitive.)

d. To which variability classes do you think these stars may correspond? Explain the criteria that you used in obtaining your answer.

Problema 4. In the previous problem you worked with ground-based data – it is time now to use space-based observations. To do this, you will gain access to the public database obtained by the CoRoT space mission, which is available from http://idoc-corot.ias.u-psud.fr/.

a. First, retrieve the public data for star with CoRoT ID 0105173544. (Don't despair if you don't find the data immediately; keep trying, and explore the interface, as if you needed this for your own research, as if you were a senior astronomer, without a teaching assistant to help you!) Plot the light curve in terms of flux vs. time, then compute the period, and plot the corresponding (phased) light curve. Pay attention to possible outliers (possibly indicative of poor measurements; exercise your judgment!), choose the axis scales sensibly… and beware of the large number of datapoints!!!

b. Next, retrieve the public data for star with CoRoT ID 0101368812, and proceed as in the previous item. What is the main difference that you note, with respect to the previous case?

c. Some stars present multiple periodicity. If you think this may be the case for either of the previous stars, apply the technique known as *prewhitening*, which consists in removing a detected period signal and its harmonics from a given dataset, so that additional periodic signals can be searched for in the resulting ("prewhitened") data. (For an example of the technique at work, see, for instance, http://adsabs.harvard.edu/abs/2009A%26A...494L..17O.) Comment on your results.